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(11) **EP 0 761 201 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
09.01.2002 Bulletin 2002/02

(51) Int Cl.7: **A61K 7/42**

(21) Application number: **96306032.2**

(22) Date of filing: **19.08.1996**

(54) **Ultraviolet radiation absorption composition**

Absorptionszusammensetzungen für Ultraviolettstrahlung

Composition à absorption de rayonnements ultraviolets

(84) Designated Contracting States:
BE CH DE ES FR GB IT LI NL

(30) Priority: **24.08.1995 US 518698**

(43) Date of publication of application:
12.03.1997 Bulletin 1997/11

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Description

[0001] This invention is concerned with composition and methods for absorbing ultraviolet radiation.

[0002] Our earlier application number EP-A-0669124 discusses the harmful effects of the solar rays and addresses the problem of providing improved compositions for screening from UV radiation.

[0003] The effectiveness of a sunscreen formulation is generally assessed by how well it protects the skin in terms of a Sun Protection Factor (SPF) which is defined as the ratio of the amount of energy required to produce a minimal erythema on sunscreen protected skin to the amount of energy required to produce the same level of erythema on unprotected skin.

[0004] A number of the chemical absorbers and physical blockers, herein after referred to as "UV radiation absorbing agents," typically used in sunscreen formulations have adverse toxicological effects. Therefore, it is desirable to reduce the level of UV radiation absorbing agents present in a sunscreen formulation without reducing the level of protection.

[0005] Grolier, U.S.-A- 4,804,531 discloses adding to a cosmetic screening composition an aqueous dispersion of water insoluble polymer particles where the polymer particles comprise a) an ionic polymer forming a core capable of being swollen, and b) a polymer forming a sheath at least partially encapsulating the core. The water insoluble polymer particles are disclosed to be film forming, to have a sheath glass transition temperature below 50 °C, and to have an average particle size before swelling of from 70 nanometers (nm) to 4500 nm. Grolier discloses that when the water insoluble polymer particles are added to a cosmetic screening composition at a level of from 0.1 to 10 weight percent, based on the total weight of the cosmetic screening composition, the absorption of UV radiation in the cosmetic screening composition is increased. The particles exemplified in this disclosure have a particle size of about 500nm.

[0006] Our earlier application disclosed compositions containing a UV absorbing agent and latex particles, such as voided latex particles in which the particle size is 100 to 500nm, with that part of this range 250nm and below being preferred, 160nm being exemplified.

[0007] We have now found that the use of latex particles having a particle size in a specifically closer, narrower, range are surprisingly and particularly effective.

[0008] The compositions of this invention contain at least one UV radiation absorbing agent and 0.1 weight percent to 50 weight percent, and preferably from 1 weight percent to 20 weight percent, based on total weight nonvolatiles, of voided latex particles having a particle size from 150 to 375nm, preferably 190 to 350nm, with the proviso that it is not 250nm or lower. The most effective size range is from 251 to 325nm. As used herein, the term "UV radiation" includes both UVA and UVB radiation.

[0009] In another aspect, this invention provides a method for improving the performance, as UV radiation adsorber, of compositions containing at least one UV radiation absorbing agent, by incorporating therein the specified amount of the specified voided latex particles.

[0010] The particle size of the latex particles in this invention is the size as measured by a Brookhaven BI-90 photon correlation spectrometer.

[0011] For a given particle size, it is desirable to produce latex particles with a maximum void fraction as current processing techniques and particle integrity will permit. Preferably, the latex particles contain a void with a void fraction of from about 0.1% to about 50%, and more preferably from about 5% to about 50%. The void fractions may be determined by comparing the volume occupied by the latex particles after they have been compacted from a dilute dispersion in a centrifuge to the volume of non-voided particles of the same composition.

[0012] The voided latex particles useful in this invention can be formed from a multistaged particle comprising at least one core polymer and at least one shell polymer. The core polymer and shell polymer may be made in a single polymerization step or in a sequence of polymerization steps.

[0013] The voided latex particles can be prepared by conventional polymerization techniques such as, sequential emulsion polymerization, including those processes disclosed in U.S.-A-4,427,836; 4,469,825; 4,594,363; 4,677,003; 4,920,160; 4,970,241 or by polymerization techniques disclosed in European Patent Application 0,267,726, European Patent Application 0,331,421, U.S. Patent 4,910,229, or U.S. Patent 5,157,084. Reference should be made to these disclosures for the general and preferred features of such processes.

[0014] The monomers used in the emulsion polymerization of the shell polymer of the voided latex particles preferably comprise units of one or more non-ionic ethylenically unsaturated monomer. Optionally, one or more monoethylenically unsaturated monomers containing at least one carboxylic acid group may be polymerized in the shell.

[0015] The monomers which comprise the shell are selected to provide a glass transition temperature (Tg) in at least one shell which is high enough to support the void within the latex particle. Preferably the Tg of at least one shell is greater than 50 °C, more preferably greater than 60 °C, and most preferably greater than 70 °C as measured by differential scanning calorimetry.

[0016] The monomers used in the emulsion polymerization of the core polymer of the voided latex particles preferably comprise one or more monoethylenically unsaturated monomers containing at least one carboxylic acid group. Preferably, the core comprises at least 5 weight percent of the monoethylenically unsaturated monomers containing at

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least one carboxylic acid, based on total monomer weight of the core. The core polymer may be obtained, for example, by the emulsion homopolymerization of the monoethylenically unsaturated monomer containing at least one carboxylic acid group or by copolymerization of two or more of the monoethylenically unsaturated monomers containing at least one carboxylic acid group. Preferably, the monoethylenically unsaturated monomer containing at least one carboxylic acid group is copolymerized with one or more non-ionic (that is, having no ionizable group) ethylenically unsaturated monomers.

[0017] The core polymer or shell polymer may optionally contain from about 0.1 weight percent to about 20 weight percent, preferably about 0.1 weight percent to about 3 weight percent, based on the total monomer weight of the core, of polyethylenically unsaturated monomer, such as ethylene glycol di(meth)acrylate, allyl (meth)acrylate, 1,3-butanediol di(meth)acrylate, diethylene glycol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, or divinylbenzene. Alternatively, the core polymer or shell polymer may optionally contain from about 0.1 weight percent to about 60 weight percent, based on the total monomer weight of the core, of butadiene.

[0018] Suitable monoethylenically unsaturated monomers containing at least one carboxylic acid group include for example acrylic acid and methacrylic acid, acryloxypropionic acid, (meth)acryloxypropionic acid, itaconic acid, aconitic acid, maleic acid or anhydride, fumaric acid, crotonic acid, monomethyl maleate, monomethyl fumarate, and monomethyl itaconate. Acrylic acid and methacrylic acid are preferred.

[0019] Suitable non-ionic ethylenically unsaturated monomers include for example styrene, vinyltoluene, ethylene, vinyl acetate, vinyl chloride, vinylidene chloride, acrylonitrile, (meth)acrylamide, (C₁-C₂₀) alkyl or (C₃-C₂₀) alkenyl esters of (meth)acrylic acid, such as methyl (meth)acrylate, ethyl (meth)acrylate, butyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, benzyl (meth)acrylate, lauryl (meth)acrylate, oleyl (meth)acrylate, palmityl (meth)acrylate and stearyl (meth)acrylate. As used herein, the term "(meth)acrylic" is intended to serve as a generic expression embracing both acrylic and methacrylic.

[0020] The void of the latex particles is preferably produced by swelling the core with a swelling agent containing one or more volatile components. The swelling agent permeates the shell to swell the core. The volatile components of the swelling agent can then be removed by drying the latex particles, causing a void to be formed within the latex particles. Preferably, the swelling agent is an aqueous base. The aqueous base useful for swelling the core includes, for example, ammonia, ammonium hydroxide, alkali metal hydroxides, such as sodium hydroxide, or a volatile amine such as trimethylamine or triethylamine.

[0021] The voided latex particles may be added to the composition with the swelling agent present in the core. When the latex particles are added to the composition with the swelling agent present in the core, the volatile components of the swelling agent will be removed upon drying of the composition. The voided latex particles may also be added to the composition after removing the volatile components of the swelling agent.

[0022] In addition to the voided latex particles, the compositions of the present invention contain at least one UV radiation absorbing agent. The UV radiation absorbing agent may be incorporated into the composition at a level to produce a desired sun protection factor. For example, the UV radiation absorbing agent may be added to the composition at a level of generally from about 0.1 weight percent to about 15 weight percent, based on the total weight of nonvolatiles in the composition.

[0023] UV absorbing agents useful in the method of this invention are generally conventional materials. Suitable UV radiation absorbing agents include, for example, oxybenzone, dioxybenzone, sulisobenzene, menthyl anthranilate, para-aminobenzoic acid, amyl para-dimethylaminobenzoic acid, octyl para-dimethylaminobenzoate, ethyl 4-bis (hydroxypropyl) para-aminobenzoate, polyethylene glycol (PEG-25) para-aminobenzoate, ethyl 4-bis (hydroxypropyl) aminobenzoate, diethanolamine para-methoxycinnamate, 2-ethoxyethyl para-methoxycinnamate, ethylhexyl para-methoxycinnamate, octyl paramethoxycinnamate, isoamyl para-methoxycinnamate, 2-ethylhexyl 2-cyano-3,3-diphenyl-acrylate, 2-ethylhexyl salicylate, homomenthyl salicylate, glyceryl aminobenzoate, triethanolamine salicylate, digalloyl trioleate, lawsone with dihydroxyacetone, 2-phenylbenzimidazole-5-sulfonic acid, benzylidene camphor, avobenzene, titanium dioxide, and zinc oxide.

[0024] The compositions of this invention may also include other ingredients useful in UV absorbing compositions. For example, if the composition is used as a sunscreen, it may additionally include water, film forming materials, emulsifiers, water, emollients, waterproofing agents, oils, stabilizers, thickeners, preservatives, perfume, colorants, insecticides, or humectants or combinations thereof. If the composition is used as a cosmetic, it may additionally include, for example, water, film forming materials, emulsifiers, softeners, emollients, oils, stabilizers, thickeners, preservatives, perfume, colorants, or pigments, or combinations thereof.

[0025] The compositions of this invention may be used in any application where protection from UV radiation is useful. For example, the improved composition may be used on human skin and hair, such as, for example personal care products, including, cosmetics, sunscreens, and hair care products. In addition, the method of this invention is also useful in improving the UV absorption and protection for coatings on plant life, plastics, wood, for example in the form of a clear varnish.

[0026] The method of this invention may be used to improve the UV radiation absorption in either clear or pigmented

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formulations. The method is particularly useful if a clear formulation is desired, such as a sunscreen formulation, because the addition of the voided latex particles having a particle size of less than about 300 nm does not significantly contribute to whiteness.

5 [0027] The method of this invention enables formulators to either increase the UV radiation absorbance of a given formulation or reduce the level of the UV radiation absorbing agent present in the formulation while maintaining a given UV radiation absorbance.

[0028] The compositions improved by the method of this invention may be applied to the skin at coating volumes, for example, of from about 0.5 microliters per square centimeter to about 4 microliters per square centimeter.

10 **EXAMPLES**

[0029] Some embodiments of the invention will now be described in detail in the following non-limiting examples. The following abbreviations are used in the Examples:

15	MMA	weight percent methyl methacrylate
	BMA	weight percent butyl methacrylate
	MAA	weight percent methacrylic acid
	Sty	weight percent styrene
20	ALMA	weight percent allyl methacrylate
	pbw	parts by weight
	*	comparative

25 [0030] For the Examples voided latex particles having particle sizes from 150 nm to 548 nm were added to formulations containing at least one UV radiation absorbing agent to determine the effectiveness of the voided latex particles in improving the absorption of UV radiation.

[0031] The voided latex particles in Examples 1 and 2 were prepared by the general method described in U.S.-A-Patent 4,427,836. The voided latex particles tested in Examples 1 and 2 had the following composition, unless stated otherwise:

30	Core	1 pbw (60 MMA/40 MAA)
	Shell I	16 pbw (10 BMA/86 MMA/4 MAA)
	Shell II	12 pbw (99.5 Sty/0.5 ALMA)
35	Shell III	9 pbw (100 Sty)

To swell the core, excess ammonia (based on the total equivalents of acid in the monomer) was added to the hot (80-85°C) dispersion between the polymerization of shell II and shell III to swell the core. The voided latex particles had a final particle size and void fraction as shown in Table I.

40 [0032] The particle size of the voided latex particles was measured using a Brookhaven BI-90 photon correlation spectrometer.

[0033] The percent void fraction of the latex particles was measured by the centrifuge method described above.

TABLE I:

45	Voided Latex Particles for the Examples		
	Latex Particles	Particle Size (nm)	% Void Fraction
	Polymer A*	150	11.3
	Polymer B*	160	10.0
50	Polymer C*	249	23.5
	Polymer D	263	28.3
	Polymer E	282	28.3
55	Polymer F*	400	36.5
	Polymer G*	548	30.5

*Polymers A, B and C are not embodiments of the invention.

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[0034] The voided latex particles were evaluated for their effectiveness in absorbing UV radiation at varying particle sizes in a composition containing at least one UV absorbing agent. The procedure used was as follows:

[0035] A test composition containing the voided latex particles to be tested was prepared according to the composition shown in Table II (Test Composition).

TABLE II:

Test Composition	
Ingredient	Parts by Weight
Deionized water	75.10
Aculyn® 22	2.25
Triethanolamine 99%	0.61
Neo Heliopan Hydro (30%)	12.00
Kathon® CG	0.04
Voided Latex Particles	10.00 (as solids)

[0036] A control composition, hereinafter referred to as "Control," was also prepared according to the composition shown in Table II, except that no voided latex particles were added. Aculyn® 22, supplied by Rohm and Haas Company, was added to the composition to provide thickening. Kathon® CG, also supplied by Rohm and Haas Company was added to the test composition as a biocide. Neo Heliopan Hydro, a UV radiation absorbing agent, is supplied by Haarmann & Reimer and is chemically phenylbenzimidazole sulfonic acid.

[0037] The ability of the test composition to absorb UV radiation was evaluated by measuring the sun protection factor (SPF) of the test composition. The SPF was measured using an SPF 290 Analyzer and SPF Operating Software supplied by The Optometrics Group located in Ayer, Massachusetts. The SPF 290 Analyzer measures the UV absorbance of a sample over UV radiation wavelengths and calculates an SPF value based on this UV absorbance spectrum. The following procedure for measuring SPF was used.

[0038] For each test composition, including the Control, a 10.16 cm long by 7.62 cm wide piece of Transpore® tape from Minnesota Mining and Manufacturing Company was cut and placed in the SPF 290 Analyzer. Using a 1.0 cc graduated syringe, 0.1 cc of the composition to be tested was evenly applied to a test area of about 50 square centimeter area. The composition was dried on the tape for 20 minutes.

[0039] While the composition to be tested was drying, a piece of tape containing no composition was measured for background UV absorbance using the SPF 290 Analyzer. The SPF 290 Analyzer subtracts the background absorbance of the tape to calculate the SPF for the test composition.

[0040] After drying, the test composition was measured for SPF using the SPF 290 Analyzer in 6 different locations within the test area of the tape. These 6 measurements were averaged together. The above procedure for measuring SPF was repeated for the same test composition, to obtain 6 additional SPF measurements. The 12 SPF measurements were averaged to obtain a final SPF.

[0041] TABLE III shows the Final SPF values for compositions which were tested according to the above procedure. Table III shows for each test composition, the latex particles which were tested, the particle size of the voided latex particles, the % void fraction of the latex particles, and the Final SPF value. A higher SPF value for a test composition indicates that a greater amount of UV radiation is being absorbed in comparison to another test composition having a lower SPF value. The data in TABLE III is also graphically shown in FIG. which shows, for the 6 UV radiation absorbing compositions, the SPF on the Y axis against the particle size, (nm) of the voided latex particles on the X axis

[0042] TABLE III and FIG. 1 confirms that the UV radiation absorbance of the test composition containing at least one UV radiation absorbing agent unexpectedly increases when the voided latex particles have a particle size of from 150 nm to 375 nm. with the greater effect over the range 190 to 350 nm. However a remarkable and quite disproportionate increase corresponds to the particle size range of 251 nm to 325nm..

TABLE III:

Final SPF Values for Test Compositions Containing Voided Latex Particles				
Composition Measured	Latex Particles Tested	Particle Size (nm)	% Void Fraction	Final SPF
Control*	None	--	--	1.3
Test composition 1*	Polymer A	150	11.3	10.5

*comparative

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TABLE III: (continued)

Final SPF Values for Test Compositions Containing Voiced Latex Particles				
Composition Measured	Latex Particles Tested	Particle Size (nm)	% Void Fraction	Final SPF
Test composition 2*	Polymer C**	249	23.5	13.0
Test composition 3	Polymer D**	263	28.3	17.8
Test composition 4	Polymer E**	282	28.3	14.3
Test composition 5*	Polymer F**	400	36.5	9.6
Test composition 6*	Polymer G**	548	30.5	9.7

*comparative

**Polymers C, D, E, F, and G were compositionally similar to polymer A.

Claims

1. A UV radiation absorber composition, comprising from 0.1 weight percent to 50 weight percent of latex particles, based on total weight nonvolatiles, wherein the composition comprises at least one UV radiation absorption agent, and wherein the latex particles contain a void and have a particle size of from 150 to 375nm, with the proviso that it is not 250nm or lower.
2. The composition of claim 1, wherein the latex particles are present in an amount of 1.0 weight percent to 20 weight percent based on total weight of non volatiles.
3. The composition of claim 1 or 2 wherein the particle size is from 190 nm to 350 nm.
4. The composition of claim 3 wherein the particle size is from 251 to 325nm.
5. The composition of any preceding claim wherein the latex particles have a void fraction of from 0.1% to 50%.
6. The composition of any preceding claim wherein the latex particles have a void fraction of from 5% to 50%.
7. The composition of any preceding claim wherein the UV radiation absorption agent comprises one or more of: oxybenzone, dioxybenzone, sulisobenzene, menthyl anthranilate, para-aminobenzoic acid, amyl para-dimethylaminobenzoic acid, octyl para-dimethylaminobenzoate, ethyl 4-bis (hydroxypropyl) para-aminobenzoate, polyethylene glycol (PEG-25) para-aminobenzoate, ethyl 4-bis (hydroxypropyl) aminobenzoate; diethanolamine paramethoxycinnamate, 2-ethoxyethyl para-methoxycinnamate, ethylhexyl para-methoxycinnamate, octyl paramethoxycinnamate, isoamyl para-methoxycinnamate, 2-ethylhexyl 2-cyano-3,3-diphenyl-acrylate, 2-ethylhexyl salicylate, homomenthyl salicylate, glyceryl aminobenzoate, triethanolamine salicylate, digalloyl trioleate, lawsone with dihydroxyacetone, 2-phenylbenzimidazole-5-sulfonic acid, benzyldine camphor, avobenzone, titanium dioxide and zinc oxide.
8. The use of latex particles as defined in any of claims 1, 3, 4, 5 or 6, to improve the UV radiation absorption of a UV radiation absorption composition.
9. The use according to claim 8 in a cosmetic sunscreen composition.

Patentansprüche

1. Eine UV-Strahlungsabsorberzusammensetzung, umfassend von 0,1 Gew.-% bis 50 Gew.-% von Latexpartikeln, bezogen auf das Gesamtgewicht der nicht-flüchtigen Bestandteile, wobei die Zusammensetzung mindestens ein UV-Strahlungsabsorptionsmittel umfaßt und wobei die Latexpartikel einen Hohlraum enthalten und eine Partikelgröße von 150 bis 375 nm aufweisen, ausgenommen eine Partikelgröße von 250 nm oder weniger.
2. Die Zusammensetzung nach Anspruch 1, wobei die Latexpartikel in einer Menge von 1,0 Gew.-% bis 20 Gew.-%,

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bezogen auf das Gesamtgewicht der nicht-flüchtigen Bestandteile, anwesend sind.

3. Die Zusammensetzung nach Anspruch 1 oder 2, wobei die Partikelgröße von 190 nm bis 350 nm beträgt.
- 5 4. Die Zusammensetzung nach Anspruch 3, wobei die Partikelgröße von 251 nm bis 325 nm beträgt.
5. Die Zusammensetzung nach einem der vorangehenden Ansprüche, wobei die Latexpartikel einen Hohlraumanteil von 0,1% bis 50% aufweisen.
- 10 6. Die Zusammensetzung nach einem der vorangehenden Ansprüche, wobei die Latexpartikel einen Hohlraumanteil von 5% bis 50% aufweisen.
7. Die Zusammensetzung nach einem der vorangehenden Ansprüche, wobei das UV-Strahlungsabsorptionsmittel eine oder mehr Verbindungen umfaßt von: Oxybenzon, Dioxybenzon, Sulisobenzon, Menthylanthranilat, Para-
15 Aminobenzoessäure, Amylparadimethylaminobenzoessäure, Octylpara-Dimethylaminobenzoat, Ethyl-4-bis-(hydroxypropyl)para-Aminobenzoat, Polyethylenglykol(PEG-25)para-Aminobenzoat, Ethyl-4-bis-(hydroxypropyl)Aminobenzoat, Diethanolaminpara-Methoxycinnamat, 2-Ethoxyethylpara-Methoxycinnamat, Ethylhexylpara-Methoxycinnamat, Octylparamethoxycinnamat, Isoamylpara-Methoxycinnamat, 2-Bthylhexyl-2-cyano-3,3-diphenyl-Acrylat, 2-Ethylhexylsalicylat, Homomenthylsalicylat, Glycerylaminobenzoat, Triethanolaminsalicylat, Digalloyltrioléat,
20 Lawson mit Dihydroxyaceton, 2-Phenylbenzimidazol-5-Sulfonsäure, Benzylidinkampfer, Avobenzon, Titandioxid und Zinkoxid.
8. Die Verwendung von Latexpartikeln wie in einem der Ansprüche 1, 3, 4, 5 oder 6 definiert zur Verbesserung der UV-Strahlungsabsorption einer UV-Strahlungsabsorptionszusammensetzung.
- 25 9. Die Verwendung nach Anspruch 8 in einer kosmetischen Sonnenschutz-Zusammensetzung.

Revendications

- 30 1. Composition absorbant les rayonnements UV, comprenant de 0,1 % à 50 % en poids de particules de latex par rapport au poids total de substances non-volatiles, dans laquelle la composition comprend au moins un agent absorbant les rayonnements UV, et où les particules de latex contiennent une cavité et ont une granulométrie de 150 nm à 375 nm, à la condition qu'elle ne soit pas de 250 nm ou moins.
- 35 2. Composition selon la revendication 1, dans laquelle les particules de latex sont présentes en une quantité de 1,0 % à 20 % en poids par rapport au poids total des matières non-volatiles.
- 40 3. Composition selon la revendication 1 ou 2, dans laquelle la granulométrie est de 190 nm à 350 nm.
4. Composition selon la revendication 3, dans laquelle la granulométrie est de 251 nm à 325 nm.
- 45 5. Composition selon l'une quelconque des revendications précédentes, dans laquelle les particules de latex ont une cavité correspondant à une fraction de 0,1 % à 50 %.
6. Composition selon l'une quelconque des revendications précédentes, dans laquelle les particules de latex ont une cavité correspondant à une fraction de 5 % à 50 %.
- 50 7. Composition selon l'une quelconque des revendications précédentes, dans laquelle l'agent absorbant les rayonnements UV -comprend- un ou plusieurs des composés suivants : oxybenzone, dioxybenzone, sulisobenzon, anthranilate de menthyle, acide para-aminobenzoïque, paradiméthylaminobenzoate d'amylo, paradiméthylaminobenzoate d'octyle, 4-bis(hydroxypropyl)para-aminobenzoate d'éthyle, para-aminobenzoate de polyéthylèneglycol (PEG-25), 4-bis(hydroxypropyl)aminobenzoate d'éthyle, paraméthoxycinnamate de diéthanoline, paraméthoxycinnamate de 2-éthoxyéthyle, paraméthoxycinnamate d'éthylhexyle, paraméthoxycinnamate d'octyle, paraméthoxycinnamate d'isoamyle, 2-cyano-3,3-diphénylacrylate de 2-éthylhexyle, salicylate de 2-éthylhexyle, salicylate d'homomenthyle, aminobenzoate de glycéryle, salicylate de triéthanoline, trioléate de digalloyle, lawson avec de la dihydroxyacétone, acide 2-phénylbenzimidazole-5-sulfonique, benzylidine-camphre, avobenzon, dioxyde de titane et oxyde de zinc.

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8. Utilisation de particules de latex selon l'une quelconque des revendications 1, 3, 4, 5 ou 6 pour améliorer l'absorption des rayonnements UV par une composition absorbant les rayonnements UV.
9. Utilisation selon la revendication 8 dans une composition cosmétique solaire.

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